Quenching star formation: insights from the local main sequence

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ABSTRACT

The so called "star forming main sequence" of galaxies is the apparent tight relationship between the star formation rate and stellar mass of a galaxy. Previous studies exclude galaxies which are not strictly "star forming" from the main sequence, because they do not lie on the same tight relation. Using local galaxies in the Sloan Digital Sky Survey we have classified galaxies according to their emission line ratios, and studied their location on the star formation rate - stellar mass plane. We find that galaxies form a sequence from the "blue cloud" galaxies which are actively forming stars, through a combination of composite, Seyfert, and LINER (Low-ionization nuclear emission-line region) galaxies, ending as "red-and-dead" galaxies. The sequence supports an evolutionary pathway for galaxies in which star formation quenching by active galactic nuclei (AGN) plays a key role.

Key words: galaxies: evolution

Burst SF   Transition?
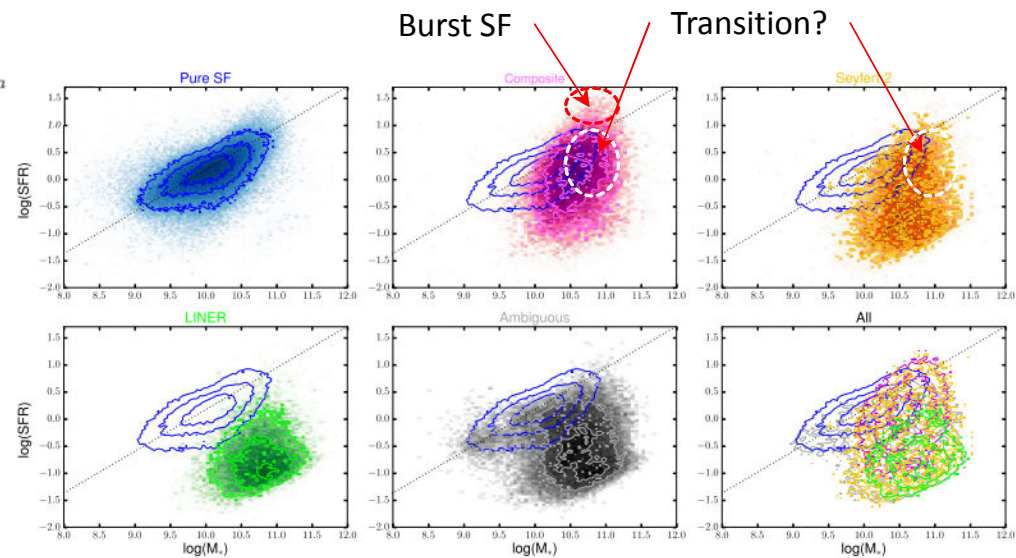
Figure 1. SFR as a function of stellar mass for each class of galaxies. Stellar mass and SFRs are in units of $M_\odot$ and $M_\odot yr^{-1}$ respectively throughout this work. The top-left to bottom-right panels include galaxies classified as purely star-forming, composite, Seyfert 2, LINER, or Ambiguous, and the final panel contains all classes together. A black dashed line in each panel represents the local MS relation for blue SDSS galaxies determined by Elbaz et al. (2007). Contours and colours represent the number density of galaxies in a single class only. Dividing the SFR-M_* space into 150x150 bins, contours are drawn at 10, 30, and 60% of the maximum number density. The blue contours of the star-forming galaxies are included in all panels to indicate the location of the star forming MS. Contours from previous panels are also shown in the final panel, which displays the MS of all galaxies.

星形成銀河の主系列図から星形成史を探る。

- ❏ SDSS DR7 20万天体 (0.04 < z < 0.1, f(Hα) > 3σ)
- ❏ 星形成率
  - ❏ 星形成銀河：Hα flux + Balmer decrement
  - ❏ それ以外：D4000 break
- ❏ 星質量：SED fit
- ❏ 輝線比診断：[OIII]/Hβ vs [NII]/Hα or [SII]/Hα or [OI]/Hα
  → SF / Composite / Sf2 / LINER / Ambiguous に分別

- ➤ 現在の主な銀河種族：星形成をしていて青い or 活動がなく赤い
- ➤ 中間的種族は少ない → 前者から後者へ短期間 (~1Gyr) で移行
- ➤ AGN host銀河は赤もしくは緑の色を持つ
  → 銀河の星形成史にはAGN feedbackの影響があるだろう

⇩

想像されるシナリオ
- ▪ Ms<1e10Msunまで星形成を継続して成長 (+ AGN feeding)
- ▪ Starburstによるoutflow、AGN jetによる gas heatingなどにより 星形成がquenched
- ▪ Red sequenceを形成

↑Fig.1: Ms vs. SFR

↓Fig.2: Ms vs. (u-r)

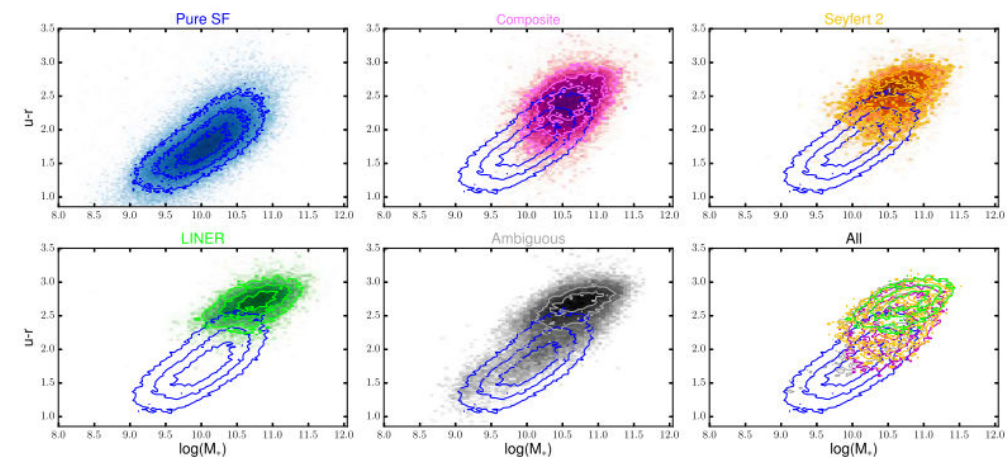| Pure SF	Composite	Seyfert 2
LINER	Ambiguous	All

Figure 2. Galaxy reddening-corrected rest-frame color as a function of stellar mass for each class. The red contour in the Pure SF panel corresponds to the same galaxies in the red contour of Figure 1. Contours are drawn at 10, 30 and 60% of the maximum density of each class of galaxy.